Washington State-Wide Master Sample

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Description of Sample Design

Target population: All streams and rivers identified by the DNR WRIA and County GIS shapefiles.

Sample Frame: To identify the target population streams, DNR WRIA and County GIS shapefiles were used. They were obtained from web sites: Data for western Washington was downloaded by county from: http://www3.wadnr.gov/dnrapp6/dataweb/dmmatrix.html. Data for eastern Washington was downloaded by WRIA from: ftp://198.187.3.44/fp/watertyping/. They were downloaded on February 22, 2005 and represent the stream network at that point in time. Note that the sample frame has streams mapped at different densities across the state. Densities are greater in "sections" of interest to DNR. Below are comments from Jennelle concerning the alternative hydrology layers available for potential use:

> "Here are clarifications on some of the hydrography data issues and questions we raised at our meeting last week.
>
> Regarding differences in stream scale/resolution among differing land ownerships across the state in the DNR hydrography layers:
> There are none. Stream linework is at 1:24,000 for ALL ownerships.
>
> Regarding what stream linework each of several existing hydrography layers contains and is based on:
> Most relevantly, the "new" DNR Hydro layer linework is based on refinement of the "old" DNR Hydro layer, not on newly-modeled linework as I had thought. I misunderstood before; the DEM was used in modeling the locations of the F/N type breaks, but those breakpoints were then transfered to the old linework. The base linework was originally developed from 7.5 minute USGS topo quads (1:24,000) for the entire state. In the early 90s, the DNR undertook to validate and refine the linework using aerial photos for all state and private lands, by township. For all townships that had ANY amount of state/private land, even a few acres, the entire township was assessed and the linework appropriately modified (including densified). This stream network has been (still in process in

Eastern Washington) further upgraded to conform with ground truthing submitted on change forms over the years. (NOTE TO DNR - what about changes noted in watershed analyses?) There are GIS attributes associated with the line segments that note their source and level of verification.

I learned of another stream layer under development in addition to the new NHD layer. FRAMEWORK is the other layer that has been developed in conjunction with the USFS, BLM and some Washington and Oregon state agencies. The Framework layer was completed 2-3 weeks ago and is based largely on the DNR Hydro layer linework but has been clipped and appended at Federal land boundaries to use those agencies' working linework. The Federal agency working linework data were also developed from 7.5 minute topos but for the most part were never photogrammetrically verified and are less dense than the DNR version. The Framework layer does not currently incorporate any Washington State stream type information and is not readily-ammenable to doing so, although there is ongoing discussion of incorporating stream types at some point in time. This layer also does not contain the last four years of DNR stream channel updates.

As we discussed on Friday, the new National Hydrographic Data (NHD) layer is also to be based on the DNR hydro layer. However, like FRAMEWORK, it has much information stripped out of it, including many the lower-order streams that we are interested in and the stream type information. It will effectively be a subset of the FRAMEWORK layer, which is in turn a subset of the DNR Hydro layer. The development status of the NHD layer is not clear to me at this time; one report is that it is completed and another is that it has yet to be begun.

My overall conclusion is that the DNR Hydrography layer is the layer to use for the statewide master sample draw. It has the most detailed, has the most up-to-date information (most submitted channel changes have been imported), has the stream type information we at CMER rely on for our studies, and is the basis for the other two primary stream channel layers that have been recently proposed for statewide monitoring. I believe it should be used for the master site draw since will be possible to select a subset of sample points that are on the other two less detailed layers whereas the opposite is not true."

Survey Design: A Generalized Random Tessellation Stratified (GRTS) survey design for a linear resource was used. The GRTS design includes reverse hierarchical ordering of the selected sites. In order to select the sample, each WRIA and county initially was used to select a master sample for that geographic unit. The sites selected were then combined into a single point shapefile for the entire state. The GRTS reverse hierarchical ordering was applied to the entire set of points (i.e., all sites were included). To overcome computational limitations, this was done by selecting GRTS samples of size 20,000 without replacement until all sites were selected. The resulting design is a spatially-balanced sample with sites in reverse hierarchical order (siteID) across the state.

Multi-density categories: None

Stratification: None.

Panels: None.

Expected sample size: Expected sample size is one site per km of stream length in the sample frame.

Over sample: None.

Site Use: Sites are listed in SiteID order and must be used in that order. All sites that occur prior to the last site used must have been evaluated for use and then either sampled or reason documented why that site was not used.

Sample Frame Summary

Total stream length (in km) is 387,235.6. Stream length (km) by WRIA or County is given below.

WRIA29	WRIA30	WRIA31	WRIA32
2913	6030	5832	6336
WRIA33	WRIA34	WRIA35	WRIA36
2088	9780	11613	5185
WRIA37	WRIA38	WRIA39	WRIA40
13789	4723	14380	2877
WRIA41	WRIA42	WRIA43	WRIA44
7453	1888	5122	3628
WRIA45	WRIA46	WRIA47	WRIA48
15650	4935	6117	10760
WRIA49	WRIA50	WRIA51	WRIA52
12879	2704	1695	7107
WRIA53	WRIA54	WRIA55	WRIA56
3247	4465	3594	1736
WRIA57	WRIA58	WRIA59	WRIA60
1804	7117	5250	6251
WRIA61	WRIA62	Clallum	clark
2791	7431	12098	3901
cowlitz	Grays Harbor	island	jefferson
13211	17420	359	11775
king	kitsap	lewis	mason
13750	1614	24765	5028
pacific	pierce	sanjuan	skagit
14908	8228	365	10188
snohomish	thurston	wahkeakum	whatcom
12024	4316	3976	9122
wskamania			
11019			

Site Selection Summary

Number of sites in sample 387,237

Description of Sample Design Output:

Variable names, descriptions, and sources of the information for the dbf file ("WA_master_strah.dbf") are contained in the excel spreadsheet: WA.DNR.NewMaster.attribute.codes.xls

Projection Information

PROJCS["NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet",
GEOGCS["GCS_North_American_1983_HARN",
DATUM["D_North_American_1983_HARN",
SPHEROID["GRS_1980",6378137.0,298.257222101]],
PRIMEM["Greenwich",0.0],
UNIT["Degree",0.0174532925199433]],
PROJECTION["Lambert_Conformal_Conic"],
PARAMETER["False_Easting",1640416.666666667],
PARAMETER["False_Northing",0.0],
PARAMETER["Central_Meridian",-120.5],
PARAMETER["Standard_Parallel_1",45.83333333333334],
PARAMETER["Standard_Parallel_2",47.33333333333334],
PARAMETER["Latitude_Of_Origin",45.33333333333334],
UNIT["Foot_US",0.3048006096012192]]

Evaluation Process

The design weights (wgt_km) are given for the master sample. When the master sample is used to specify a design for a particular study, the weights will need to be modified to reflect the number of sites selected and the survey's domain. Typically, users prefer to replace sites that can not be sampled with other sites to achieve the sample size planned. The site replacement process is described above. When sites are replaced, the original survey design weights are no longer correct and must be adjusted. The weight adjustment requires knowing what happened to each site in the base design and the over sample sites. An EvalStatus attribute should be added to the specific survey, initially set to "NotEval" to indicate that the site has yet to be evaluated for sampling. When a site is evaluated for sampling, then the EvalStatus for the site must be changed. Recommended codes are:

EvalStatus Code	Name	Meaning
TS	Target Sampled	site is a member of the target population and was sampled
LD	Landowner Denial	landowner denied access to the site

PB	Physical Barrier	physical barrier prevented access to the site
NT	Non-Target	site is not a member of the target population
NN	Not Needed	site is a member of the over sample and was not evaluated for sampling
Other codes		Many times useful to have other codes. For example, rather than use NT, may use specific codes indicating why the site was non-target.

Statistical Analysis

Any statistical analysis of data must incorporate information about the monitoring survey design. In particular, when estimates of characteristics for the entire target population are computed, the statistical analysis must account for any stratification or unequal probability selection in the design. Procedures for doing this are available from the Aquatic Resource Monitoring web page given in the bibliography. A statistical analysis library of functions is available from the web page to do common population estimates in the statistical software environment R.

For further information, contact

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